FORESTRY FOCUS

2008 Forestry Related Activities of Resource Science Division

April 2009
Missouri Department of Conservation

Seventy-six Conservation Area – Photo by: Dawn Henderson

Executive Summary

Forestry Focus is an annual report of forestry-related research conducted by the Resource Science Division of the Missouri Department of Conservation. The purpose of *Forestry Focus* is to annually report on accomplishments and on-going research initiatives. The report was designed for MDC resource managers, but should be of interest to other land managers and the general public. It provides an insight into current and proposed research in support of sustainable and healthy forest communities.

We provide brief descriptions for 34 studies conducted in 2008 or planned for 2009. We also provide citations, web links, and e-mail addresses for the main contact persons following each summary to provide additional sources of information. WE conducted our research in collaboration with hundreds of resource managers and scientists from several state and local agencies and universities within and outside of the state.

These studies encompass community restoration, ecosystem management, system ecology, forest economics, and forest health. These comprehensive studies support MDC's Next Generation Goals:

- Conserving plants, animals, and their habitats.
- Protecting clean and healthy waters.
- Promoting healthy trees and forests.

Technology transfer was central o the Resource Science Staff activites during the year. It was accomplished through conferences, workshops, science notes, peer-reviewed journal articles, and other in-house publications promoting the relevance of research to resource managers and the public. WE welcome your feedback and ideas for improving *Forestry Focus* or on research initiatives. We look forward to working with you in the coming year.

2008 *Forestry Focus* Committee

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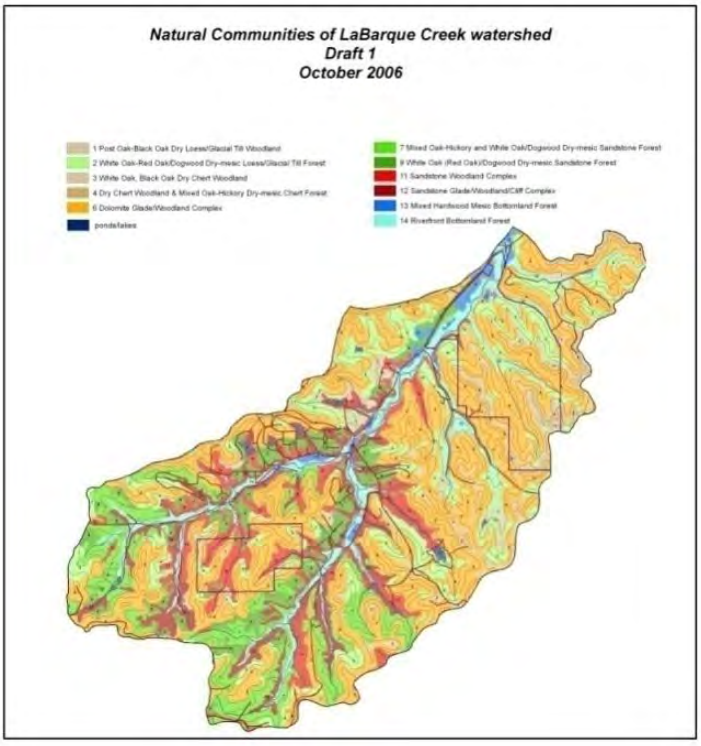
Nodaway Valley Conservation Area – Photo by Dawn Henderson

Ecological Landtype Mapping

Missouri Ecological Classification Project Continues

Project Leader: Tim Nigh (MDC).

Summary of activities/findings: The ECS Project completed definitions and GIS coverages of Ecological Landtypes (ELTs) for the Outer Ozark Border, Springfield Plain, and Chariton River Hills using the Missouri digital soil survey during 2008. In the process, we gained a better understanding of NRCS Ecological Site Descriptions (ESDs); they are essentially the same as ELTs. Consequently, we have worked to streamline a statewide soils database with eight essential soil properties. Using these, we are grouping soils into ecological soil groups. The potential natural community of each group will be determined next. Field verification over the next two years will verify these soil-vegetation relationships and lead to definitions and maps of statewide ELTs/ESDs. An example of the map product appears below.



Plans for 2009: Results will be published as USFS General Technical Reports and will be posted online through MDC GIS databases and the NRCS Web Soil Data Viewer.

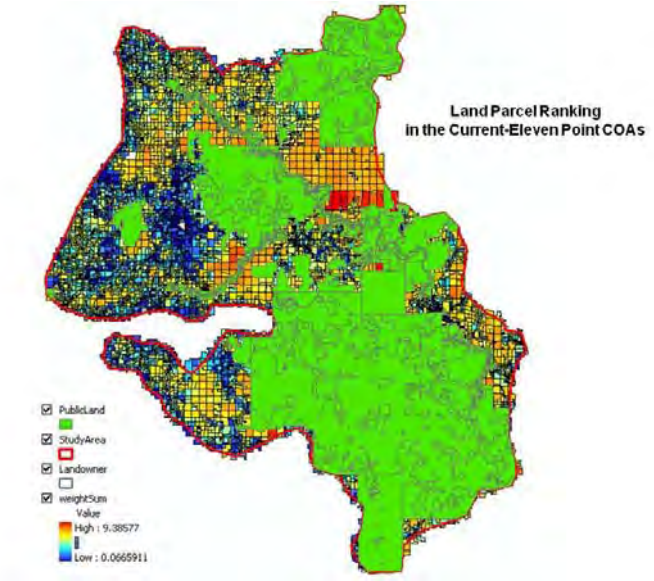
For more information: Tim Nigh@mdc.mo.gov

Land Parcel Ranking in the Current-Eleven Point COA

Project Leader: Tim Nigh (MDC).

Objective: The goal of the land parcel-ranking project is to rank all private land parcels using multiple conservation values.

Graphics (left and right) by: Tim Nigh.



Summary of activities/findings: During 2008, we acquired and digitized parcel maps for the eight counties touching the Current-Eleven Point COAs. We also created coverages of multiple factors including parcel size, percent forest, length riparian corridor, heritage sites, adjacency to public land, road lengths, etc. An ArcGIS model has been created that allows flexible use of the information to weight factors and define conservation value scores for each parcel.

Plans for 2009: These ranks will be used to guide a landowner survey and contact strategies. An example of a land parcel ranking output is presented in the above graphic. This work is being conducted at the UM, Columbia, Department of Geography by

Dr. Linkui Li. The Nature Conservancy and Wildlife Diversity Fund Grant have supported this work.

For more information: Tim Nigh@mdc.mo.gov

Shortleaf Pine and Natural Communities

Landowner attitudes toward shortleaf pine restoration

Project leader: David Gwaze (MDC).

Collaborators: Heather Scroggins, Tom Treiman, Ron Reitz, and Michelle Baumer (MDC).

Objectives: To assess private landowner attitudes, understanding, and awareness of shortleaf pine restoration.

Summary of activities/findings: Private landowners were selected for participation in focus groups using data from the George O. White Nursery and information provided by the Private Land Services Division staff. Focus groups were held April 14, 2007 at Rolla and Houston, and May 19, 2007 at Eminence and West Plains. At each venue, private landowners were split into two groups – 1) those that had restored shortleaf pine, and 2) those that had not. Each group numbered 6-12 people.

Reasons for growing shortleaf pine were as varied as the participants themselves, including aesthetics, recreational value, habitat suitability, ~~"re~~restoration ethic", legacy motivations, and economics. Even in the ~~"n~~on" shortleaf pine focus group, participants expressed an interest in growing pine if they could learn more about it.

Growing shortleaf pine is not without its challenges. Participants experienced problems with drought, deer damage, and a minority expressed concern with the timing of receiving seedlings from the state nursery. For those who were economically motivated, prices for their products, a dependable market for saw timber, and a use for the sawmill waste were given as limiting factors to their success. Participants felt that education and assistance would greatly benefit them. Educational brochures, on-site visits from subject matter experts, assistance with labor and equipment, as well as on the ground demonstration areas were suggested.

For more information: David.Gwaze@mdc.mo.gov

Relationship between wood density and drill resistance

Project leader: David Gwaze (MDC).

Collaborators: Aaron Stevenson (MDC), Rich Guyette and Mike Stambaurgh (UM, Columbia), and Charly Studyvin (USDA Forest Service, NRS).

Objectives: 1) To determine the relationship between wood density and drill resistance, and 2) To determine the genetic parameters for wood density and drill resistance for shortleaf pine.

Summary of activities/findings: Wood density is an important wood quality trait. Inexpensive, reliable, and rapid methods for assessing wood density are lacking. A new device called the Resistograph has the potential for rapid assessment of wood density for standing trees. The Resistograph variables are based on drilling resistance along a small needle path when drilled into a tree at constant speed. As the drill penetrates the tree, changes in amplitude are printed on a graph and data are stored in the internal memory of the device. The relationship between wood density and drill resistance, measured by a Resistograph, was investigated in a shortleaf pine population at age 25. At the individual-tree level the linear relationship between wood density and drill resistance (amplitude) was weak and positive ($R^2 = 0.23$), but was stronger ($R^2 = 0.47$, Figure 1) at the mean family level. The efficiency of using the Resistograph to indirectly select for improvement of wood density was 86%. These findings suggest that the efficiency of indirectly selecting for wood density using drill resistance was nearly as efficient as directly selecting on wood density itself; suggesting that amplitude is a good selection criterion for wood density in shortleaf pine. Thus, using the

Resistograph appears to be a rapid, non-destructive, and inexpensive method of measuring wood densities of live trees in a shortleaf pine breeding program.

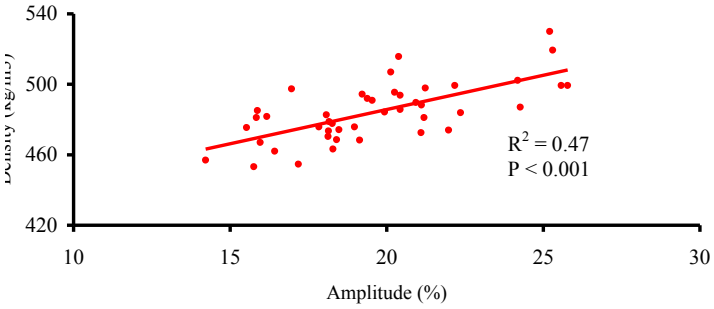


Figure 1. Relationship between wood density and amplitude (Resistograph drill resistance) at the mean family level.

Future direction: Despite our findings, further studies using different Resistograph models (e.g. the more advanced B-series model) and verifying results with those from other tests at different locations and ages are necessary to improve effectiveness of using drill resistance as a surrogate for wood density in shortleaf pine improvement stands.

For more information: David.Gwaze@mdc.mo.gov

Citation and link: Gwaze, D. and A. Stevenson. 2008. Genetic variation of wood density and its relationship with drill resistance in shortleaf pine. Southern Journal of Applied Forestry 32(3):130-133.

Optimum selection age for height

Project leader: David Gwaze (MDC).

Collaborators: Charly Studyvin (USDA Forest Service, NRS), Ross Melick (Retired, USDA Forest Service), and Mark Coggeshall (UM, Columbia).

Objectives: The objective of the study was to estimate optimum selection age for height in shortleaf pine.

Summary of activities/findings: While rotation length for agricultural crops is short and individuals with desired traits can be selected directly, in forest trees rotation age is long, and therefore early selection is preferred. Early selection is an indirect selection where performance at a young age is used as an indicator of performance at maturation. Selecting early, rather than direct selection at rotation age is expected to increase gain (i.e. height) per unit of time through reduced generation intervals and reduced testing costs.

Genetic and phenotypic correlations for height were estimated for shortleaf pine from a single progeny test comprising 44 half-sibling families assessed at ages 3, 5, 7, 10, 17 and 25. The age-age genetic correlations for height ranged from 0.68 to 0.99, and phenotypic correlations ranged from 0.28 to 0.84. Early selection efficiency for height was examined using the ratio of gain per year between indirect early selection and direct selection at age 25. Given the flowering age of shortleaf pine in Missouri, the best age to make selections was predicted to be 10 years. The information obtained here will guide selection decisions in the shortleaf pine progeny test established at George O. White Nursery in 2002 and for other future progeny tests.

For more information: David.Gwaze@mdc.mo.gov

Citation and link: Gwaze, D. 2009. Optimum selection age for height in shortleaf pine. New Forests 37: 9-16.

Regeneration alternatives for shortleaf pine after clearcutting

Project leader: David Gwaze (MDC).

Collaborator: Mark Johanson (MDC).

Objective: The objective of the study was to compare survival, growth, and hardwood competition among three site preparation and two regeneration methods.

Summary of activities/findings: In 1986, three site preparation methods (prescribed burn, bulldozer, and no preparation) and two regeneration methods (planting and natural) were tested at the Current River Conservation Area. Eighteen years after establishment, the unprepared naturally regenerated treatment had only 38 stems/ac. The burn and planted treatment had 290 stems/ac. The bulldozed

and planted treatment had 672 stems/ac. Mean volume growth per tree was greatest in the doze treatment at 50% greater than that in the burn treatment, and more than twice that in the control treatment. As expected, hardwood competition was greatest in the control treatment (1252 stems/ac) followed by the burn treatment (988 stems/ac) and least in the bulldoze treatment (484 stems/ac). Results from this study suggest that natural regeneration does not meet adequate stocking level goals and seedlings established using this method exhibited poor growth. They also suggest that planting on sites prepared by prescribed burning is a viable method of restoring mixed shortleaf pine – oak forest type but not for shortleaf pine dominated forest type.

For more information: David.Gwaze@mdc.mo.gov

Bottomland Forest and Natural Communities

Riparian Ecosystem Assessment and Management (REAM) project

Overview: In 1993, the MDC initiated the REAM project to determine the effects of timber harvesting on plants and animals in a riparian forest in northeastern Missouri. The REAM project was established at three conservation areas (CAs) owned and managed by MDC—Atlanta CA, Deer Ridge CA, and Mussel Fork CA. At Deer Ridge CA, the REAM project was designed as an experiment with five silvicultural treatments applied during 1999 and early 2000: 1) growing season clearcut, 2) growing season basal area retention (BAR) harvest, leaving 4.6 m^2 basal area/ha of ~~"d~~esirable" species, 3) dormant season clearcut, 4) winter BAR harvest, and 5) unharvested control. Pre-treatment data were collected in 1997 and post-treatment data were collected in 2001, 2002 and 2003. For more information, see the full report on REAM:

Stump sprouting success

Project leader: Tony Elliott (MDC).

Collaborators: Brian Root (USDA Fish and Wildlife), David Gwaze and Sherry Gao (MDC), and John Kabrick (USDA Forest Service, NRS).

Objectives: Quantify and compare stump sprouting of different hardwood species in a Northeast Missouri riparian forest.

Summary of activities/findings: We evaluated the stump sprouting success of various hardwood species in a riparian forest at Deer Ridge Conservation Area (CA) in Lewis County, Missouri. We measured 1511 stumps from felled trees at least 4.5 inches dbh in the clearcut and thinned stands (residual basal area was 25 to 30 ft^2 per acre). An additional 838 stumps of selected species less than 4.5 inches dbh in the clearcut stands were also measured.

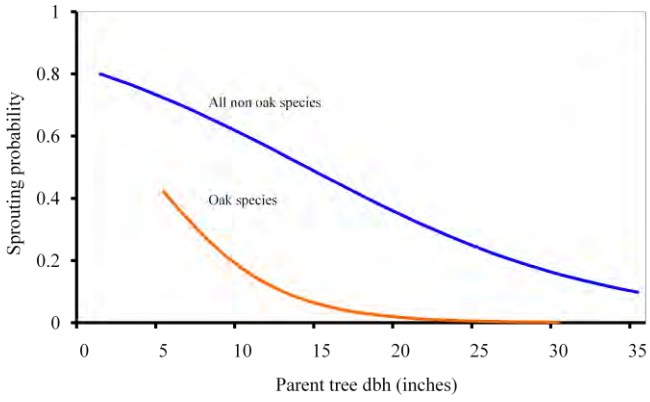


Figure 2. Sprouting probabilities of oak and non-oak species at Deer Ridge CA after one growing season.

Sprouting percentages between the clearcut and heavy thinning treatments were not significantly different, so data were combined. The sprouting response for all species and sizes combined was strong with 66% of stumps having at least one live sprout after one growing season, 63.2% after two growing seasons, and 59.9% after three growing seasons. Stumps of large (≥ 4.5 inches dbh) sycamore, green ash, hackberry, American elm and silver maple all showed a strong sprouting response after the first growing season and did not show a major drop in the percentage with live sprouts three years after harvest. In contrast, the oak species (pin

oak and white oak group) stumps were rare and had poor sprouting success (<17% of stumps with live sprouts after three growing seasons). Cottonwoods sprouted well initially (44.3%), but by the third growing season the percentage of stumps with live sprouts dropped to only 4.7%. River Birch sprouted poorly and after three growing seasons only 2.6% of the stumps had live sprouts. Small trees (< 4.5 inches dbh) of all species sprouted well. For all species, sprouting probabilities decreased with increasing diameter (see Figure 2). As stump diameter increased, sprouting probabilities dropped more rapidly for the oak species than for all other species combined. For example, the sprouting probability of a 19-inch non-oak tree was 42%, while that of an oak tree of the same size was only 6%.

The poor sprouting success of oaks, especially compared to more abundant competitor species, at Deer Ridge CA suggests that stump sprouting plays a minor role in regenerating oaks at this riparian forest. Future oak component in this riparian forest could be increased by underplanting and controlling the understory.

Plans for 2009: Data analyses on vegetation components of the project will continue. We hope to develop a proposal to re-sample the vegetation plots in 2012. This re-sampling will provide substantial opportunities to measure changes in tree growth rates, survival, species composition and abundance, snag dynamics, and ground-layer vegetation. Further measurements in the REAM project are needed as the forest changes under different management practices. Additional information will increase the quality of data as well as our understanding derived from REAM.

For more information: Tony.Elliott@mdc.mo.gov

Effects of site preparation methods and stock types on oak establishment in bottomlands

Project leader: Jeff Esley (MDC).

Collaborators: David Gwaze and Dawn Henderson (MDC).

Objectives: To evaluate two site preparation methods and three planting stock types.

Summary of activities/findings: The two site preparations included rotary brush shredder and complete plot clearing with a bulldozer. The three stock types were natural regeneration, bare-root seedling, and containerized seedlings (RPM). Basal area was reduced to 50 sq ft/acre to ensure adequate light levels for all stock types. Additionally, a cover crop was planted to reduce weedy and light seeded tree competition.

In 2008 (after one growing season), the study was assessed for height, basal area, diameter, and survival. Survival for all stock types was high: 76% for natural seedlings, 87% for bareroot seedlings, and 93% for RPM seedlings. There were no statistical differences in survival between sites prepared by the brush shredder (87%) and those prepared by the dozer (86%). As expected, RPM seedlings were taller and had bigger basal diameters than bareroot and naturally regenerated seedlings ($P < 0.001$), but the two site preparation methods were not significantly different for all growth traits. Despite deer rubbing and browsing, mean height growth increments after the first growing season were higher for RPM and natural seedlings (0.3 ft) than for bareroot seedlings (0.1 ft).

Plans for 2009: Growth and survival measurements will occur on an annual basis. Light availability (transmittance) will be tracked on a yearly basis to develop the relationship between site preparation, planting stock type, species, and biomass accumulation.

For more information: Jeff.Esley@mdc.mo.gov

Riparian Reforestation

Project leader: Randy Jensen (MDC).

Collaborators: Kyle Steele (UM, Columbia), David Rowold, Brian Hall, Marty Calvert, Mark Johanson, Nate Forbes, Brad Pobst, Paul Blanchard, and Greg

Hoss (MDC), and John Kabrick and Dan Dey (USDA Forest Service, NRS).

Objectives: The objectives of this study were: 1) to compare the growth and survival of planted tree seedlings in riparian zones using a variety of tree species and planting treatments, and 2) to compare the ground flora and natural regeneration response to different tree planting treatments.

Summary of activities/findings: Kyle Steele finished his Master's degree from the University of Missouri with a replicated experiment as part of this study. Kyle evaluated 13 tree species (1/0 bare root seedlings) planted at three Ozark sites using five management treatments in the year of planting. Roundup® was used as site preparation prior to implementing study treatments. The treatments included 1) Roundup® only, 2) growing season treatment of Poast Plus® 3) redtop grass cover-crop; 4) white clover cover-crop; and 5) Virginia wild rye cover-crop, a native species. After two growing seasons, tree survival was similar between treatments. Trees grew slightly taller in cover crops; the best results were found in the redtop treatment. However, large differences in survival rates and height growth were found among species. Green ash, white ash, swamp white oak, bur oak, northern red oak, and black walnut all had >90% survival. Cottonwood (16%), pecan (58%) and sycamore (74%) had the lowest survival rates. When cottonwood did survive, it reached approximately one meter in height. Sycamore reached a height of 45 cm, while hackberry and pecan each showed a decline in height due to shoot dieback (-12 cm and -4 cm, respectively).

2006 tree planting operation. Photo by: Randy Jensen.

For the management evaluation portion of this study, ground flora data was collected on five sites in the 2006 tree plantings. Tree growth and survival data was collected in six sites that were planted in 2005 and 2007. Data collection continues on this portion of the study.

Plans for 2009: Ground flora data will be collected after three growing seasons in the 2007 tree plantings at three study sites. Seedling growth and survival data will be collected after four growing seasons in the 2006 plantings at three sites that were part of the above mentioned thesis work and also for a private land planting. Natural regeneration data will be collected in early 2009 on the 2005 tree plantings

For more information: Randy.Jensen@mdc.mo.gov or Kyle.Steele@mdc.mo.gov

Upland Oak and Natural Communities

2008 Oak Mast Status

Project leader: David Gwaze (MDC).

Collaborators: MDC Forestry Division.

Objectives: The oak mast survey is conducted annually by Forestry Division staff to provide an index of the availability of oak mast, giving us an indication of what is in store for mast-dependent forest wildlife during fall and winter.

White oak acorns. Photo by: David Gwaze

Summary of activities/findings: Oak mast is a very important source of fall and winter food for many species of wildlife, particularly in the heavily forested portions of the state. Poor mast years have resulted in lowered reproductive success in, and reduced numbers of, wildlife, which can influence hunter success. In areas with poor mast crop or during poor mast years, wildlife are more likely to be feeding around agricultural areas and forest edges, rather that the forest interior. Additionally, mast production is essential for oak regeneration. *Summary of activities/findings*: This year Missouri Forestkeepers helped conduct the survey. A total of 6,277 oak trees were assessed for acorn production. Combining the two oak groups, mast production is better than last year. This year's mast index is 104, an increase of 17% over last year's index. However, overall mast production is 22% lower than the 49-year average. This year's red oak mast production is the lowest on record (Figure 3). This year's red oak production is 68% lower than the 49-year long-term average and 70% lower than last year's production. White oak index is good and 23% higher than the 49-year average, and five times higher than last year's index.

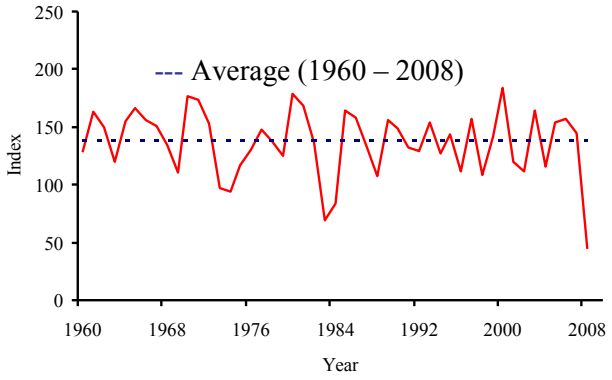


Figure 3. Statewide mast index for red oaks, 1960-2008.

The poor red oak mast production is attributed to the 2007 spring freeze, which destroyed their flowers. Because red oak acorns take two years to develop, the impact of the freeze was a mast failure this year. In white oaks, production of acorns takes place in the same season the flowers are fertilized; hence, the freeze reduced their mast production last year. This year's favorable weather increased white oak mast production.

The importance of maintaining mixed stands of red oaks and white oaks in order to avoid complete mast failures cannot be overemphasized.

For more information: David.Gwaze@mdc.mo.gov

Effects of Thinning Eastern Red cedar

Project leader: David Gwaze (MDC).

Collaborator: Greg Cassell (MDC).

Objectives: The objective of this study was to determine effect of thinning on diameter growth and heartwood formation in eastern red cedar.

Summary of activities/findings: The impact of thinning on diameter, basal area, heartwood width, and sapwood width was studied in a 40-year-old pure stands of eastern red cedar at a site near Branson, Missouri. Mortality was high in unthinned plots and non-existent in thinned plots, 40 years after thinning. Mean tree diameter, basal area growth rate, and heartwood width were higher in thinned than in unthinned plots. In contrast, no significant difference in sapwood width was found between thinned and unthinned treatments. A strong linear relationship between heartwood width and diameter was observed ($R^2 = 0.94$, Figure 4), indicating that the amount of heartwood was directly related to the size of the tree. A weaker relationship was obtained between diameter and sapwood width ($R^2 = 0.52$). Thus, in addition to increasing growth, thinning increased the heartwood width of eastern red cedar. Thinning is recommended as a sound management practice for eastern red cedar.

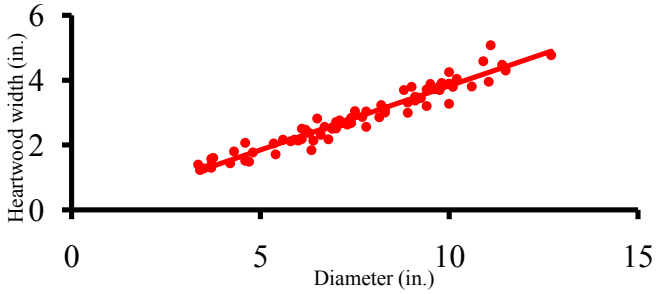


Figure 4. Eastern red cedar heartwood width as a function of tree diameter 40 years after thinning.

Eastern red cedar logs. Photo by: David Gwaze.

For more information: David.Gwaze@mdc.mo.gov

Horse Trails on Public Forests and Other Lands: Survey of Missouri Riders

Project leader: Tom Treiman, Heather Scroggins, and Michele Baumer (MDC)

Objectives: To improve our knowledge of Missouri's equestrians, their preferences and habits, the Missouri Department of Conservation conducted a scientific survey of more than 5,000 users between February and June of 2008. We surveyed saddle clubs, trail ride operators, and individuals, seeking solid, statewide information to help set department policies and make informed decisions when planning for equestrian trail use.

Summary of activities/findings: Recommendations of the study include establishing better signage that clearly identifies trailheads and designated trail routes. The results of our survey also include creation of a multi-agency web site that lists and describes trails, trail regulations, lists of open and closed trails, as well as the desire for trail improvement for poor conditioned trails or trails long enough to support a half-day ride. Survey results also indicate public support for closing trails that cannot be made safe and inviting if resources are not available. We recognize the importance of the Missouri equestrian experience. As we balance natural resource stewardship with recreational development and responsible fiscal management, MDC should work with public and private partners to implement the recommendations identified by the survey.

Photo by: Tom Treiman.

For more information: Tom.Treiman@mdc.mo.gov

Link: http://mdc.mo.gov/trails/

Habitat, Population Status, and Management of Tall Larkspur

Project leader: Alicia Mullarkey (MDC).

Collaborators: Susan Farrington and Dan Drees (MDC).

Objectives: 1) assess current status of tall larkspur populations within Missouri, and characterize habitat in which it is found, and 2) examine potential threats to tall larkspur population viability in Missouri and determine what types of management might benefit populations.

Tall larkspur. Photo by: Alicia Mullarkey.

Summary of activities/findings: Tall larkspur (*Delphinium exaltatum*), is a plant species of conservation concern in Missouri and is considered imperiled within the state (S2) and globally vulnerable (G3). This plant species occurs in just two counties in Missouri (Shannon and Howell), and nine states nationwide. We characterized all historic and new tall larkspur populations in Missouri to better understanding the ecology and the management needs of this species. Of the 13 populations with historic data in the Natural Heritage Database, five populations show significant signs of decline, six appear relatively stable, and two populations have increased in size. Reproductive plants comprised between 0-53% of each population. Populations with the largest proportion of reproductive plants were located in areas with semi-open canopies, including one along a roadside, two riparian sites, one ~~"m~~managed" by beavers, and one managed with fire in 2007. The majority of populations were located in dry-mesic woodlands on steep slopes featuring dolomite outcropping and well-drained calcareous soils above both perennial and intermittent streams. The maintenance of an open habitat with partial shade appears to be important for the long-term viability of these populations. Of particular concern is the encroachment of Eastern red cedar and sugar maple into tall larkspur sites. Sites where tall larkspur occurs would most likely benefit from periodic dormant-season burning and/or mid-canopy thinning to maintain more open canopy conditions.

Plans for 2009: Project is completed.

For more information:
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Missouri Ozark Forest Ecosystem Project (MOFEP)

Overview: This project began in the late 1980's from discussions concerning the impact of clearcuts on Neotropical migrant, forest interior birds. The idea expanded to become a long-term evaluation (100+ years) of multiple ecosystem facets. It is designed as an experiment with three treatments: 1) even-aged management, 2) uneven-aged management, and 3) no harvest. Pre-treatment data were collected starting five years before the initial harvest entry in 1996. The next harvest entry is scheduled for 2011. For more information, see the MOFEP website: http://mofep.mdc.mo.gov/

2008 MOFEP/SAF workshop for managers

The Missouri Society of American Foresters in collaboration with the Missouri Department of Conservation held the 2008 SAF/MOFEP workshop with the theme "~~L~~earning while Managing Forests at a Landscape Scale – Lessons from MOFEP", October 21-22, 2008 in West Plains, Missouri. The purpose of the workshop was to communicate MOFEP research findings and their implications to land managers.

The workshop was attended by 93 participants including forest consultants, students, private landowners, personnel from MDC, USFS, USDA-NRCS, Universities (MU and Toledo), and industry.

The workshop was a great success. It brought together a diverse group of people to learn and discuss the latest research information from one of the most comprehensive ecosystem projects in the nation. It provided a forum to discuss how even-aged and uneven-aged management were applied in the last stand entry and how they will be applied in the next entry harvest in 2011.

Changes in Soil Nutrient Cycling and Availability

Project leader: David Gwaze (MDC).

Principal Investigator: Keith Goyne (UM, Columbia).

Collaborators: John Kabrick (USDA Forest Service, NRS), Peter Motavalli (UM, Columbia), and Mike Wallendorf (MDC)

Objectives: The objective of the study is to investigate forest harvest management effects on nutrient pools and cycles in soils at MOFEP.

Summary of activities/findings: A total of 486 soil samples were collected to conduct laboratory experiments and analyses for investigating changes in total soil nitrogen (N), potentially mineralizable N, the distribution of N in labile and stable soil N pools, and exchangeable base cations that occur after even- and uneven-aged forest harvest. One-half of each soil sample collected was placed in polyethylene bags, sealed, and stored at 4^{o}C. The remaining sample was placed in polypropylene storage tubs and air-dried upon return to the laboratory. Organic matter on the surface (O horizon) was also sampled and placed in paper bags, air-dried upon return to the laboratory, ground and stored in plastic bags at 4^{o}C. After air-drying, 250 soil samples were ground and sieved to 2 mm and sent to the Missouri Soil Characterization Lab for physical and chemical analyses. Soil texture, cation exchange capacity, exchangeable cations, pH, exchangeable acidity, and organic carbon content are in the process of being quantified for each sample. The data will be used to determine any differences in pH and base cation contents in soils across map units and harvest treatments. Experiments have been initiated to determine relative potentially mineralizable N using an aerobic incubation and leaching procedure. The estimated completion time for incubation experiments is April 2009.

For more information: David.Gwaze@mdc.mo.gov

Down Dead Wood in Managed Forests

*Project Leader***:** Randy Jensen (MDC)

*Collaborators***:** Daniel Dey and Stephen Shifley (USDA Forest Service, NRS)

Objectives: The objectives of this study were 1) to quantify the volume and ground coverage of coarse woody debris resulting from even-age, uneven-age, and no-harvest management at the landscape level on MOFEP sites and 2) compare Brown's fuels transect data on MOFEP sites to areas with a variety of long-term forest management histories and findings to forest structure.

Summary of activities/findings: Down dead wood transects (228 feet) were completed on all 648 MOFEP plots. Approximately 30% of the data collected along study transects was completed during the 2009 winter season. For consistency in data collection, the minimum parameter for the dead down wood was two inches. Brown's fuel transects, including fine fuels, were completed by the Northern Research Station (USDA Forest Service) on 507 MOFEP plots. These data will be compared with data collected at 250 plots at Chilton Creek Restoration Project and 100 plots at Pioneer Forest's continuous forest inventory (CFI) plots.

Measurement of down dead wood. Photo by: Randy Jensen.

Plans for 2009: The Forest Service will continue fuels data collection on areas that have known even-aged management or frequent burn histories for restoration purposes.

For more information: Randy.Jensen@mdc.mo.gov

Citations:
Spetich, M.A., S.R. Shifley, and G.R. Parker. 1999. Regional distribution and dynamics of coarse woody debris in Midwestern old-growth forests. Forest Science 45:302-313.

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Carbon Flux and Storage in Mixed Oak Forests of MOFEP

Project Leader: Randy Jensen (MDC)

Principal Investigator: Jiquan Chen, University of Toledo

Collaborators: Jianye Xu and Mike Deal (University of Toledo); and John Kabrick (USDA Forest Service, NRS)

Objectives: To quantify differences in carbon flux and storage within mixed oak forests of the Southeastern Missouri Ozarks resulting from alternative management practices. The MOFEP experimental units were used to measure and model, ecosystem carbon flux. This project seeks to address questions of carbon flux and sequestration, as well as the compounding impacts of global climate change and forest management. Specifically we wanted to address: 1) continuation of field measurements of various carbon (C) flux/stocks associated with soil and vegetation measurements (e.g., microclimate) to understand the intra-annual variability (i.e., climate controls) following the alternative treatments, 2) evaluate detailed biogeochemical regulations of the C cycle, including water-, light-, and nutrient use efficiencies, and 3) model and predict the changes in C credits of different silvicultural options and landscapes (i.e., remote sensing and ecosystem modeling).

Summary of activities/findings: In addition to continuation of our field measurements of C flux and storage, we focused primarily on carbon loss of different MOFEP management units in 2008 because carbon loss of deciduous forests plays a determinant role in net ecosystem carbon credits. We found that the annual losses of carbon from ecosystem respiration were 1642, 1691, and 1286 g C m^{-2} y^{-1} in the no-harvest (NHM), uneven-age harvest (UAM), and even-age harvest management (EAM) stands, respectively. Timber harvesting reduced respiratory loss in the EAM stands compared to that in the NHM stands by 27.7%. The largest component of this loss in all treatments was soil respiration, which contributed between 72 to 85% of the total loss. In the NHM stands, leaf respiration and sapwood (both about 10%) were the next largest component of carbon loss, followed by snags (5%) and down dead wood (2%). In the UAM stands, the second largest contributing factor was leaf respiration (7%), followed by sapwood (7%), snags (6%), and down dead wood (2%). In the EAM stands, down dead wood (12%) was the second largest factor, followed by sapwood (2%), leaf (1%), and snags (0%).

Soil carbon flux measurement. Photo by: Randy Jensen.

Plans for 2009: We will continue the proposed field measurements of carbon flux and collaborate with the overstory project to quantify the carbon stock and changes over the past 20 years of the MOFEP experiment. A second focus will be to examine the intra-annual variation of ecosystem respiration since 2004. Finally, we will attempt to link Landsat images to our study sites to examine the spatial distribution of carbon across the Ozark landscapes.

For more information: Randy.Jensen@mdc.mo.gov

Citations and links:
http://research.eeescience.utoledo.edu/lees/research/MOFEP/

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MOFEP Ground flora/ soft mast study

Project leader: Susan Farrington (MDC).

Collaborators: Randy Jensen, Jenny Grabner, Debby Fantz, and Steve Sheriff (MDC).

Objectives: To regenerate sustainable oak-hickory forests and woodlands while maintaining or restoring native ground flora natural communities and encouraging production of key wildlife forage through soft mast production.

Plant community sampling. Photo by: Susan Farrington.

Summary of activities/findings: Preliminary analysis of ground flora data from 1993-2007 was completed. The emphasis of analysis thus far has been restricted to woodland plant communities of MOFEP (85% of our plots are in woodlands). We looked at species richness and percent cover of plants grouped by community type and conservatism. In the ~~"no~~ harvest" woodland sites, we saw decreases in species richness and conservatism. In the intermediate thin treatments, we saw a brief but moderate increase in species richness (lost by 2007), and conservatism remains steady. In clearcut treatments, we saw a large increase in species richness, but also a decrease in conservatism. While this might imply a gain in weedy species, a closer look reveals an increase in moderately conservative woodland species in our clearcut treatments, and only slight increases in generalist or ruderal species. Percent cover changes also reflect an increase for woodland species of moderate to high conservatism. Our findings imply that in the absence of fire, substantial harvest is required to increase light to sufficient levels necessary for stimulating woodland flora. Findings were presented at the Society of American Foresters MOFEP workshop in October 2008 and at MNRC in February 2009 (see link below).

Plans for 2009: Full-scale monitoring will be conducted in 2009 and 2010 to establish pre-treatment condition prior to harvest in 2011.

For more information:
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Fire Ecology

Monitoring pine-oak woodland restoration at Rocky Creek CA

Project leader: Aaron Stevenson (MDC).

Collaborator: Gary Gognat (MDC).

Objectives: to monitor pine regeneration and other vegetation responses following prescribed burning and four thinning treatments: 1) intermediate thinning and timber stand improvement (ITSI), 2) non-commercial woodland thinning (NCW), 3) uneven-aged management (UEAM), and 4) shelterwood (SHW).

Summary of activities/findings: All harvests were concluded in 2004, and a prescribed fire was implemented in March 2006. Vegetation data (See Figure 5) was collected in the summer of 2005 (post-harvest & pre-burn), 2006 (post-burn), and 2007. Results indicate that the species richness of ground flora increased at all sites treated, but the increase was minimal at the NCW sites. The SHW and UEAM sites had the largest increase in species richness among all sites. Preliminary results indicate that thinning and prescribed fire treatments are having a positive impact on ground flora diversity.

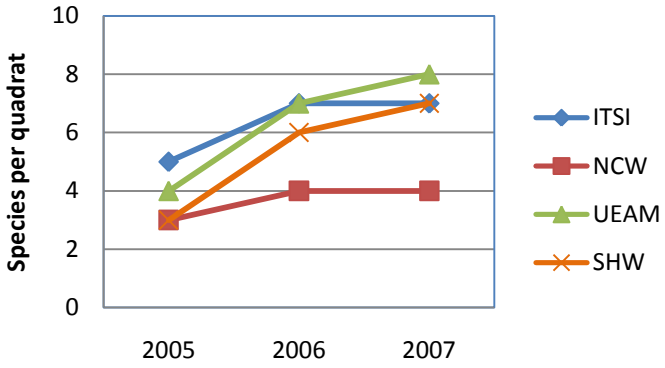

Figure 5. Number of species each year in each treatment.

Plans for 2009: Initial sampling efforts failed to characterize accurately the distribution of pine seedlings across the landscape, so future efforts will focus on targeted sampling of pine regeneration.

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Monitoring fall and spring burning in a post oak woodland at Fourche Creek CA

Project leader: Aaron Stevenson (MDC).

Collaborators: Steve Paes and Susan Farrington (MDC).

Objectives: to monitor vegetation responses following fall and spring prescribed fires in a post oak woodland.

Summary of activities/findings: Prescribed fire was implemented in fall of November of 2005 and March of 2006. We analyzed vegetation data collected from 2005 (pre-burn), 2006 (first year post-burn), and 2007. The results indicate that grass and sedge cover increased from 4% to 35% in fall burned plots. The spring burn increased grass and sedge cover from 3% to 11% from 2005 to 2007, while the unburned plots showed no increases. Species richness increased in both fall and spring burn plots, and remained unchanged for unburned plots.

Plans for 2009: If the weather cooperates and we can prescribe fire, we will measure fire behavior in the monitoring plots.

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Photo by: Steve Paes.

Prescribed fire effects on the wood quality of oak and shortleaf pine

Project leader: Richard Guyette (UM, Columbia).

Collaborators: Michael Stambaugh and Rose-Marie Muzika (UM, Columbia), and Aaron Stevenson (MDC).

Objectives: to examine the number, anatomy, and ecology of fire scars resulting from prescribed fire in Ozark uplands.
Summary of activities/findings: Results indicate that 50% of trees were scarred on northeast slopes and 64% were scarred on southwest slopes. Fire scar size and time since fire were the most important variables affecting decay and timber quality for scarlet oak, black oak, and white oak. Five years

following a fire, only about 1% of total volume was affected for scarred oak trees. Small fire scars formed decades ago in oak did not greatly increase decay. These results indicate that managers can mitigate losses to timber trees, due to prescribed burning, by harvesting trees soon after a fire injury is formed or by minimizing fire intensity and subsequent fire scar size.

Plans for 2009: This project is completed, but results from this research will help guide other projects examining prescribed fire effects on timber resources.

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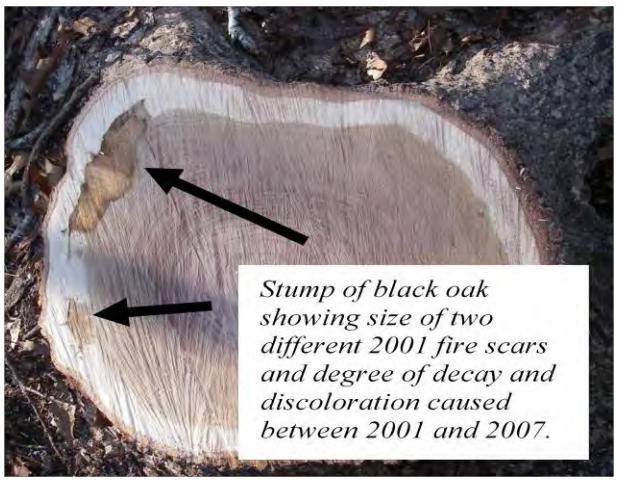

Photo by: Aaron Stevenson.

Relating ignition pattern, fire intensity, and topography to scarring in hickories and oaks

Project leader: Aaron Stevenson (MDC).

Objectives: 1) determine whether managers can effectively use ignition pattern to control fire intensity and minimize fire-related injuries on timber resources, and 2) determine how landscape variables and fire intensity relate to the frequency and size of fire scars in oaks and hickories.

Summary of activities/findings: Fire scar data were collected from two burn units at Peck Ranch CA and one burn unit at TNC's Chilton Creek Management Preserve. Bark scorch height, a proxy for fire intensity, proved to be a useful predictor of the number and size of fire scars found across all three sites. Preliminary analysis shows a strong correlation between fire intensity and the distribution of large fire scars across the landscape. Mapping fire intensity and scarring data provided a useful means for visualizing the landscape-level effects of prescribed burning on fire scars.

Plans for 2009: A final report will be prepared.

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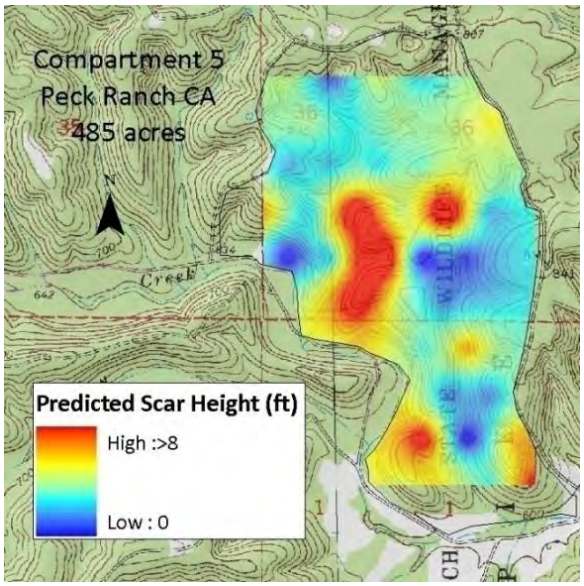

Graphic by: Aaron Stevenson

Validating time-dependent tree defect models and determining lumber yield changes for prescribed fire injured oak trees

Project leaders: Richard Guyette and Michael Stambaugh (UM, Columbia).

Collaborators: John Tuttle and Aaron Stevenson (MDC).

Objectives: 1) document the influence of time on the effects of fire scars and wood defects, and 2) determine lumber yield changes from fire scarring through the grading and milling of fire-scarred logs. This project will build upon an earlier study examining fire effects on wood quality, and the

results will be coupled with results from a fire scar study to aid managers in determining the long-term impacts of prescribed burning on timber resources.

Summary of activities/findings: The preliminary proposal was developed and reviewed in October, and a final proposal was submitted in December. *Plans for 2009*: Pending budget approval, selection of study sites will begin summer 2009. Sites considered relevant for the study are mixed oak woodlands. These types of sites have the potential to be unburned and develop into quality forestlands or burned and develop into quality woodlands or savannas.

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Prescribed fire effects on an Ozark landscape at The Nature Conservancy's (TNC) Chilton Creek Management Preserve

Project leader: Doug Ladd (TNC).

Collaborators: Aaron Stevenson and Susan Farrington (MDC), Neal Humke and Hilary Hayley (TNC).

Objectives: 1) to monitor the long-term landscape-level effects of prescribed burning and 2) to contrast responses at these study sites with MOFEP findings.

Summary of activities/findings: Prescribed burning at the five management units began in 1998. Pretreatment data were collected in 1996 and 1997, and post-treatment data were collected in 2001 and 2002. Sampling years at Chilton Creek are scheduled to coincide with sampling years at MOFEP to reduce year-to-year variation in vegetation comparisons between the two studies. Vegetation sampling at Chilton Creek is identical to sampling at MOFEP, allowing a direct comparison of vegetation responses from harvest treatments and landscape-level prescribed burning.

Vegetative response to fire treatments. Photo by: Aaron Stevenson.

Plans for 2009: In May crews will begin collecting ground flora data in the 250 one-half acre permanent monitoring plots.

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Nursery Production

Freeze Damage to Seedlings at the George O. White State Nursery

Project leader: David Gwaze (MDC).

Collaborator: Greg Hoss (MDC).

Objectives: The objective of this study was to evaluate the spring freeze of 2007 and its damage to seedlings at the George O. White State Forestry Nursery.

Summary of activities/findings: During late March and early April 2007 unusually warm weather was followed by unusually cold weather (see Figure 6), causing extensive damage to newly germinated seedlings at the State Nursery. The minimum temperature of 16°F recorded on April 8 was the lowest ever recorded on that day at the state nursery. The bitter cold lasted seven days.

The unusual warm weather caused seedlings to come out of dormancy and seeds to germinate early. The freeze that followed the warm weather severely damaged newly germinated seedlings. It was estimated that over 500,000 newly germinated seedlings were lost to the freeze. Those that had not germinated or were much older (e.g. one- and two-year old seedlings) were not affected. The species that were severely affected by the freeze included eastern red cedar, aromatic sumac, Osage orange, choke cherry, dogwood (flowering, gray, red ozier, roughleaf, and silky), ninebark, sweet gum, Washington hawthorn, white ash and blackberry. Some species appeared to be resistant to the freeze. For example, little damage was done to plum and black cherry, although they too had germinated early. The freeze substantially reduced revenue from the nursery.

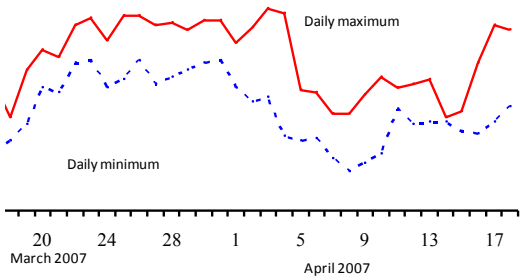

Figure 6. Maximum and minimum temperatures for the George O. White nursery, Licking, Missouri; March and April 2007

For more information: David.Gwaze@mdc.mo.gov

http://oak.snr.missouri.edu/mosaf/2008/Spring08.pdf

Forest Health

Missouri Forest Health Program

Project leaders: Rob Lawrence, Bruce Moltzan, and Mark Schall (MDC).

Collaborators: Dennis Haugen, Manfred Mielke, Mike Connor (USDA Forest Service, NRS).
Objectives: Conserve Missouri's forest resources by monitoring and evaluating forest health and providing forest health management information to the people of Missouri.

Summary of activities/findings: A major change in the Forest Health Program occurred recently in staffing. After serving as MDC's forest pathologist for eight years, Bruce Moltzan departed in July 2008 to take on national program responsibilities with the USDA Forest Service in Washington, D.C. We welcomed Mark Schall as our new forest pathologist in January 2009. Mark recently completed his Ph.D. at Pennsylvania State University and brings experiences in forest management, research in forest pathology, and teaching.

Dr. Mark Schall. Photo by: Rob Lawrence

Forest health diagnostic results and management recommendations were provided by program staff to over 800 contacts (phone calls, e-mails, letters, laboratory reports, and site visits). Laboratory Technician Donna Brandt did an excellent job performing diagnostic lab duties and providing tree disease management information to cooperators and landowners while the pathologist position was vacant.

Two issues of the Missouri Forest Health Update newsletter and a Forest Health Alert (jumping oak gall) were produced and distributed to MDC staff, arborists, forestry consultants, university, and government cooperators. Forest pest management seminars were presented to commercial arborists, community foresters, park & recreation staffs, Master Naturalists, Missouri Pesticide Applicator

Training Program, and others. Additional information was distributed through media interviews and media releases.

Plans for 2009: Monitoring, evaluation, and outreach efforts will continue as program emphases. Invasive species, particularly the emerald ash borer, will comprise a much larger portion of those efforts than in past years. Annual forest health training sessions for MDC staff will be initiated in Spring 2009 as part of the new Forestry Division Training Academy.

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Emerald Ash Borer Program

Project leaders: Rob Lawrence and Justine Gartner (MDC), Collin Wamsley (MO Dept. Agriculture).

Collaborators: Mike Brown and Christopher Pierce (USDA-APHIS-PPQ), Tim Banek and Matt Seek, Southeast Region Forestry staff (MDC), Doug LeDoux and Anastasia Becker (MO Dept. Agriculture), Mike Currier (MDNR) Dennis Haugen, Steve Katovich, and Paul Strong (USDA Forest Service, NRS), James Gracey (US Army Corps of Engineers), and many other partners.

Emerald Ash borer adult. Photo by: David Cappaert, Forestry Images.

Objectives: Reduce the risk of introduction, increase readiness to respond to infestations, detect infestations, and mitigate impacts of the emerald ash borer (EAB), *Agrilus planipennis*, in Missouri.

Summary of activities/findings: The multi-agency Missouri EAB Technical Team completed the Missouri EAB Action Plan in May 2008. Directors of the Missouri Departments of Agriculture, Conservation, and Natural Resources signed the Plan in June.

The first known EAB infestation in Missouri was detected on July 23, 2008 in Wayne County in southeastern Missouri. EAB was detected when seven adults were captured on a sticky trap at the U.S. Army Corps of Engineers' Greenville Recreation Area. This trap was part of annual EAB detection surveys in which high-risk sites across the state are monitored with one or more survey techniques. High-risk sites are those receiving firewood, ash logs, or ash nursery stock.

Monitoring techniques included a new type of sticky trap (monitored by USDA-APHIS), visual surveys (Missouri Department of Agriculture), and detection trees (University of Missouri Forestry crew). Detection trees are ash that are stem-girdled in the spring and then felled, debarked and examined in the fall. All survey sites were negative for EAB, except at the Greenville location where one of four sticky traps and all three detection trees were positive for EAB.

Following confirmation of the EAB infestation, a visual survey at the Greenville site revealed many infested trees within a one-mile radius of the positive trap. A subsequent dendrochronological analysis by USDA-APHIS indicated that the infestation has been present at least 5 to 6 years. Movement of infested firewood into the Recreation Area campground is the presumed pathway of EAB introduction. State and federal quarantines were implemented on Wayne County prohibiting movement of regulated articles (deciduous firewood, ash trees, their components, and emerald ash borers). In the fall, the Army Corps of Engineers began removing and destroying ash trees near the Recreation Area in an attempt to slow the spread of the infestation.

Emerald ash borer larva and S-shaped tunnel. Photo by: Rob Lawrence.

Public outreach efforts coordinated by the multi-agency EAB Communications Team continued to increase in 2008. A public meeting was held in Greenville on August 25 where state and federal officials answered questions about the infestation and quarantine. Information was expanded on the MDC web site. A web-based reporting form and a toll-free phone number were set up at MDC by which the public could submit questions or reports of suspected EAB infestations. MDC Forestry and Resource Science Division staffs monitor and respond to these web and phone reports. University of Missouri Extension established a comprehensive EAB web site. A new brochure, *Emerald Ash Borer CSI*, was developed by a multi-agency committee and produced by MDC to assist the public in diagnosing EAB infestations in their trees. EAB brochures and posters were mailed to public and private campgrounds throughout Missouri. Public service announcements, web-based videos, and media releases were produced, and presentations were given at numerous workshops, fairs, and stakeholder group meetings.

An EAB Pathways Committee with members from state and federal agencies and industry stakeholder groups was formed to evaluate how to reduce the risk of EAB movement and introduction, particularly via the main pathway of firewood movement.

Plans for 2009: MDC Resource Science and Forestry Divisions staff will continue to respond to public contacts received via phone and web-based reporting concerning possible new infestations. Resource Science, Forestry, and Outreach & Education Divisions staff and the Invasive Species Coordinator will be involved in several outreach efforts, e.g., presenting EAB seminars and workshops statewide, and developing and distributing outreach materials.

EAB survey efforts will increase in 2009. USDA-APHIS plans to monitor approximately 1,000 sticky traps surrounding the known infestation in Wayne County and in adjacent counties. Missouri Department of Agriculture will monitor approximately 200 sticky traps and conduct visual surveys at other high-risk sites across the state. The Wayne County EAB infestation will be evaluated by a project led by the Missouri Department of Agriculture, in partnership with the U.S. Forest Service, Army Corps of Engineers, and the MDC Forest Entomologist. Plans call for 1) using detection trees to precisely determine the extent of the EAB infestation, and 2) conduct an ash inventory near the known infestation to determine the host resource at risk for future infestation. This type of information is required for planning future EAB management efforts.

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Links: http://mdc.mo.gov/forest/health/ashborer or http://eab.missouri.edu/

Missouri Cooperative Gypsy Moth Survey

Project leaders: Rob Lawrence (MDC leader) and Collin Wamsley (Missouri Dept. Agriculture, Statewide project leader)

Collaborators: Rob Emmett, Nate Forbes, Joe Garvey, Tom Draper, Lonnie Messbarger and others (MDC), Jimmy Williams, (MO Dept. Agriculture), Mike Brown, Brian Deschu (USDA-APHIS-PPQ), Dennis Haugen (USDA Forest Service), and other members of the Missouri Gypsy Moth Advisory Council.

Objectives: Detect the presence of gypsy moth populations, (a highly damaging invasive forest pest that is expanding its range toward Missouri from the northeastern U.S.).

Summary of activities/findings: The annual cooperative gypsy moth survey is led by the Missouri Department of Agriculture. Approximately 11,800 pheromone traps were placed and monitored statewide by six state and federal agencies May to August 2008. A total of 10 gypsy moths were captured, four in St. Louis County, two in Franklin County, and one each in Jackson, Ozark, Webster, and Wright Counties. These captures are likely the result of gypsy moth egg masses or other life stages hitchhiking on interstate movement of goods and vehicles. No gypsy moth populations are known to be established in Missouri.

Gypsy moth female and egg mass. Photo by: Jim Rathert.

MDC's role in the survey consisted of, in part, placing and monitoring 4,827 traps in 27 counties in St. Louis, Ozark, Southeast, and Northwest Regions. Supervision and support of survey crews was provided by Forestry Division. MDC Resource Science Division provided all necessary GIS and data management services statewide to the six cooperating agencies.

Plans for 2009: The annual survey will be continued in a similar manner in 2009. Locations where gypsy moths were captured in 2008 will be surveyed at a greater trapping density to detect possible established populations.

For more information:
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Link: http://www.mda.mo.gov/pi/pdf/gypsymothsurvey.pdf

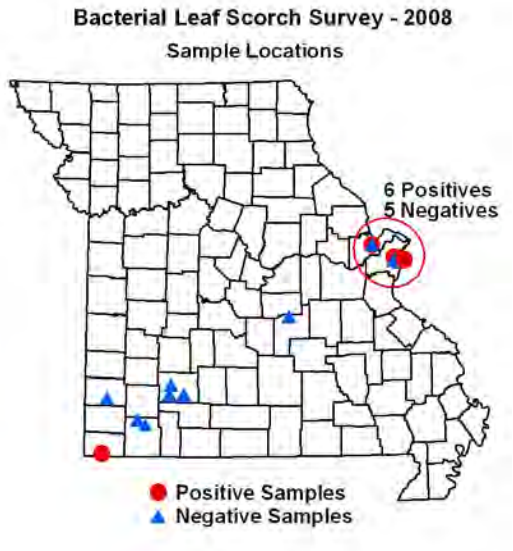
Bacterial Leaf Scorch Survey

Project leaders: Gerry Adams (Michigan State University) and Bruce Moltzan (MDC).

Collaborators: Donna Brandt, Mark Grueber, and Cindy Garner (MDC), and Jim Jacobs (National Park Service).

Objectives: Determine incidence and distribution of bacterial leaf scorch on hardwoods in the North Central and Plains States.

Summary of activities/findings: Bacterial Leaf Scorch (BLS) is a disease caused by the bacterium *Xylella fastidiosa* that affects oaks and many other hardwood tree species. Leaf scorching symptoms are followed by premature leaf drop and eventual tree mortality. Symptoms can be confused with those of oak wilt, drought scorch, other diseases, and abiotic stresses. In 2008, the MDC Forest Health staff and other Missouri cooperators participated in a multi-state survey to determine the incidence and distribution of BLS. Suspect leaf samples were collected in an area stretching from southwestern to east central Missouri and submitted to Dr. Gerry Adams at Michigan State University for testing. Of 19 total samples submitted, seven were positive for *Xylella fastidiosa*, including five from pin oak and one from white ash in the St. Louis area and one from pin oak from McDonald County.



Graphic by: Donna Brandt.

Plans for 2009: MDC will continue to contribute samples for the ongoing multi-state survey.

For more information: Mark.Schall@mdc.mo.gov or Rob.Lawrence@mdc.mo.gov

Link: http://www.apsnet.org/online/feature/bls

Forest Economics

Forest Inventory and Analysis (FIA National Grid)

Project leader: Tom Treiman (MDC) and Keith Moser (USDA Forest Service, NRS).

Objectives: As part of the USDA Forest Service national program to monitor forest acreage, biomass, volume, growth, removals, and mortality, plots continued to be visited by Forest Service foresters, and a suite of plot, tree, forest health and other measures are taken on each.

Summary of activities/findings: This year's annual report focused on the potential impacts of Emerald Ash Borer in Missouri. The report also covers statistical findings of forest acreage, biomass, volume, growth, tree removal, and mortality as well as discussions of specific Missouri issues. Data is also available on the web.

For more information: Tom.Treiman@mdc.mo.gov

Citation and links: Moser, W.K., M.H. Hansen, S.J. Crocker, and T.B. Treiman, 2008. Missouri's forest resources, 2007. Res. Note. NRS-29. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p. http://nrs.fs.fed.us/pubs/rn/rn_nrs29.pdf

United States Forest Service. 2007. Forest Inventory Data Online (FIDO). http://199.128.173.26/fido/index.html

The Economic Impacts of Emerald Ash-Borer

Project leaders: Tom Treiman, Justine Gartner, and Johnny Tuttle (MDC).
Objectives: MDC public contact personnel, industry and community leaders, and decision makers inside and outside of government needed information on the possible impacts of emerald ash borer on the Missouri economy. This information can help us understand the costs and benefits and best design of quarantines or other regulations that may help slow or stop the spread of emerald ash borer.

Adult EAB. Image credit: Howard Russell, Michigan State University.

Summary of activities/findings: If EAB becomes established statewide, Missouri's forest-based economy will lose over $6.7 million annually. The economic impact due to the loss of ash street trees is harder to estimate. It is comprised of the trees' aesthetic value, costs of removal, loss of property values, and impact on home-cooling costs. The one-time cost, spread out over many years, could reach $20.3 million for Missouri.

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Timber Product Trends Report

Project leaders: Tom Treiman and John Tuttle (MDC).

Objectives: Changes in timber prices (by product and species) are tracked by reports from forester-assisted timber sales on both private and public land. Price trends are reported to foresters, landowners, and academics. This project continues annually.

Photo by: Tom Treiman.

Summary of activities/findings: Four times a year, MDC and private foresters were contacted and asked to report volumes, prices, and conditions of all timber sales they had assisted or conducted. Data are used to produce four short publications of quarterly price trends. Each publication also includes updates on regional and national trends and issues affecting timber prices.

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